

MODE-ENHANCED HINDUSTANI MUSIC

TECHNICAL FIELD

5 The present invention is related generally to systems of music, and more particularly, to a method and apparatus for employing mode-enhanced Hindustani Music.

BACKGROUND

10 Music is a combination of rhythm and melody. Melody, or *raag* (*raaga*), is generally understood as a sequence of notes, each of which is a single pitch or a single uniform sound associated with a set of frequencies, out of which one of the frequencies influences how the note sounds. Pitch is usually calculated by a measure of periodicity of waveforms based on $\pi = 3.1416$.

15 The Western musical system contemplates 12 notes in an octave, of which 7 are "natural" notes; the remaining 5 notes are either "sharp" or "flat" notes and lie between the 7 natural notes. These notes are arranged in a sequence of pitches from left to right, whereby if a note is positioned to the right of another note, the one on the right has a higher pitch.

20 Scales are combinations of notes. Though it is possible to construct a large number of scales by combining the notes in different ways, in practice there are a few scales that occur more frequently than the others. The starting note of a scale is called a "root note."

25 A key concept in producing musical melody is the avoidance of dissonance, which is also known as overtone interferences between successive notes. Overtone interference hampers the identification of an individual note. To avoid overtone interference, a number of interval systems have been in practice, for example, Pythagorean, mean tone, equal temperament, and just intonation, which are used in the Western music systems. It should be noted that the Western musical system is typically an "equal temperament" system; successive notes are equidistant, i.e., they are separated by equal frequency ratios.

Unlike Western musical systems, the East Indian musical systems are closer to "just intonation" systems—successive notes are not equidistant. In the East Indian musical system, there are seven notes called *swaras*. "*Raaga*" is considered similar to scale, and "*shruti*" is similar to "root note". *Shruti* intervals, which are 22 in number, are thought of as the foundation of *swaras*. The seven notes are: *Shadj*, *Rishabh*, *Gandhar*, *Madhyam*, *Pancham*, *Dhaivat*, and *Nishad*. These are usually represented in an abbreviated form: *Sa*, *Re (re)*, *Ga*, *Ma*, *Pa*, *Dha*, and *Ni*.

Mode is a way to describe the varying positions of these scales. Mode is called "*thata*" in Hindi. The concept of *thata* is old; it was described several thousand years ago as "*jati*." *Thatas* or modes are variant scales developed from a major scale simply by starting from a different note. Some of these *thatas* were termed *Shuddha*, meaning "pure" *jatis*, which were formed by taking a natural scale and producing other scales by simply shifting the tones. This method changed with fixing the interval for the 5th tone, the *Pancham*.

The important contribution by the eminent Hindustani musicologist, Pandit Bhatkande (1860-1936), who first attempted to systematize the Hindustani music, resulted in casting all *raagas* into only 10 *thatas*, which limits the Hindustani music severely. Some attempts were made to rectify this situation and identify other possible *thatas* from a theoretical point of view, but these attempts were not successful. Accordingly, the Hindustani musical system can be improved by using a systematic approach to identifying additional *thatas* or modes.

SUMMARY

Hindustani music is found to have an additional 22 *thatas* (modes) that can be scientifically and accurately computed. Together with the 10 *thatas* already identified, these newly identified and compiled *thatas* make a total of 32 *thatas*. In a further aspect, a *raaga* or melody is constructed by a combination of ascending and descending notes by selecting a *thata*, and computing a combination including at least 5 ascending or descending notes for the *thata*. An additional feature of the present invention is that new *raagas* can be formed with the 10 *thatas* that are currently in use as well as from the

newly identified 22 *thatas*. Accordingly, in one aspect, this method systemically produces new *raagas*.

Further, new musical instruments can be constructed by applying the newly identified *thatas*. Students of music may be taught new tunes based on the 32 *thatas*.

5 Also discovered is a method of programming a musical instrument such as the sitar to produce tunes in accordance with the method described herein. Further, the method may be programmed to a general-purpose digital computer to produce new forms of melodious music.

10 BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, objects and advantages of the presently described invention may be more readily understood from the following detailed description with reference to the accompanying drawing, in which,

15 Fig. 1 illustrates 32 *thatas*, which can be derived from 462 *thata* combinations screened to use one *swara*.

DETAILED DESCRIPTION

20 As stated above, because of the difference in ratios on which the scales are fixed, the modes identified for the South Indian music are not directly applicable to the *thata* system of the Hindustani music. The 10 *thata* system, which has been in vogue, has restricted the potential of the Hindustani music. This system is based on aural recognition of the notes rather than being on a sound scientific basis. Though instruments
25 used in the creation of Hindustani music such as the Sitar use moveable frets to enable the creation of several types of tonal scales, typical Hindustani music has not deviated from the traditional 10 *thata* system because other *thatas* have not been identified or compiled in an accurate way to enable proper teaching or learning.

Thatas form the basis of a *raag* in the Hindustani music. A *thata* lays down the
30 conditions to generate a particular melody from the notes of a *thata*. A *thata* may be used to generate a melody (*raaga*) by choosing a particular set of notes as per the definition of

Raagas. From a *thata* one can create further combinations of *raagas*. It should be noted that a *thata* is a precondition to the creation of a *raaga*. Using the existing 10-*thata* system can result in a limited number of *raagas*, and in practice there are about 100 *raagas*, and it is believed that this has restricted the scope and opportunity for the growth of Hindustani music. Of the 32 *thatas* identified herein, there are newly identified 22 *thatas*.

It has been observed that a scientific and mathematical approach to identify and compile new *thatas* to be used in Hindustani music system would enhance the state of the art. Accordingly, a theoretical model has been created using mathematical analysis and a scientific approach to compile additional *thatas* to enrich the Hindustani music system. The methodology used first creates a set of rules, which could be applied in a systematic way.

As is common with the traditional Hindustani music, a *thata* includes a selection from 7 *swaras*. Advantageously, these 7 *swaras* are selected from the set of 12 *swaras* used in Hindustani music, namely, {*SA*, *re*, *RE*, *ga*, *GA*, *ma*, *MA*, *PA*, *dh*, *DH*, *ni*, *NI*}. In the notation used herein, lowercase letters indicate that the note is a flat (*komal*) and uppercase letters indicate pure note (*shuddha*), except that the note *MA* is a sharp note (*teevra*). Importantly, the notes *SA* and *PA* are mandatory in every *thata* created. Each *thata* includes a selection of at most only one form of each of the 7 basic *swaras*, i.e., either *shuddha*, *komal* or *teevra* form of a particular *swara*.

RAAGAS IN HINDUSTANI MUSIC

Raagas are melody types. As stated above, the *raaga* system is a method of organizing tunes based on certain natural principles. Tunes in the same *raaga* use the same (nominal) *swaras* in various combinations and with practice the listener can pick up the similarity. Each *raaga* has a *swaroop* (a musical form or image) that is defined by the *swaras* used, the *gamakas* given to these *swaras*, the sequence in which the *swaras* occur.

Notes are classified as *vadi*, *samvadi*, *anuvadi* and *vivadi*. The note most frequently used in a *raaga* is called *vadi*. *Samvadi* is a note separated by 8 or 12 *srutis* from *vadi*. *Vivadi* is a note in opposition to *vadi*. *Anuvadi* is a neutral note. As an

example, the following notes stand in *vadi* relationship with each other: $\{SA-PA\}$, $\{RE-DHA\}$, $\{GA-NI\}$, $\{ma-SA\}$.

5 *Aroha* is a sequence of *swaras* used in a *raaga* in the ascending passages i.e. as the pitch goes up. *Avaroha* is the sequence of *swaras* to be used in descent. The *aroha* and *avaroha* (or the scale) of a *raaga* provide an outline upon which the rest of the *raaga* is formed. To achieve a *raaga*, more than simple selection of *aaroha* or *avaroha* is necessary. Thus, it can be seen that *raagas* are not simply abstract collections of *swaras* that occur together to produce a tune. Each *raaga* has a distinct image or *swaroop*, and this is what defines a *raaga*. An arbitrary selection of a set of *swaras* is unlikely to produce a distinct *raaga swaroop* and this is the reason for attributing the foundations of the *raaga* system to nature. From the viewpoint of a listener, a realization of the *raaga swaroop* means that some of the qualities of the music can be anticipated and this contributes greatly to listening pleasure.

15 The well-known *raagas* are the products prior work by eminent musicians. Each *raaga* has associated with it a feeling that it induces in the listener and the performer. Hours of dedicated practice with a single *raaga* results in the realization of the *raaga swaroopa* on the part of the performer and this is often referred to as obtaining a *Dharshan* of that particular *raaga*. The unfortunate consequence of this is that various performers have slightly different mental concepts of a single *raaga* and this is manifest in their music. This adds to the creation of music immensely, which is why East Indian music is typically not learnt from a book but through a *Guru* (master) who can portray the *raaga swaroop* in such a manner that the pupil can pick it up. This form of instruction from a master is called *Guru-Sishya Parampara*.

25 Further notice should be made that a *thata* has *aaroha* (ascending order of notes) and *avaroha* (descending order of notes) but in general no *vadi/samvadi*. A *thata* with *vadi/samvadi* is a *sampurna-sampurna raaga*.

TYPES OF RAAGAS (BASE AND DERIVED)

Raagas fall into two types, base or *Janaka* (i.e., "mother" *raaga*) *raagas* and derived or *janya* (i.e., offspring) *raagas*. *Janaka raagas* have a formal structure and follow a fairly rigid scheme of scientific organization whereas the *janya raagas* are rooted in usage and evolve with the music. In fact many *janya raagas* change their character over time. *Janya raagas* are derived from the base *raagas* through various means as described subsequently. *Janaka raagas* are identified by the fact that they use all seven *swaras* and the *aroha* and *avaroha* are always {Sa,Ri,Ga,Ma,Pa,Da,Ni,Sa} and {Sa,Ni,Da,Pa,Ma,Ga,Ri,Sa}. This type of *aroha* and *avaroha* is denoted by the term *sampoorna*, indicating completeness. The existence of multiple *swara sthanas* for Ri, Ga, Ma, Da and Ni implies that by collecting combinations of these, we can form a system of *Janakas*. Any *raaga* that does not belong to the *Janaka* system is a *janya raaga*. *Janya raagas* are characterized by missing notes in the *aroha* and/or *avaroha* {e.g., Sa-Ri-Ga-Pa-Da-Sa}, the use of twisted progressions {e.g., Sa-Ga-Ri-Ma-Pa-Da-Ni-Sa}.

The definition of *Janaka* given above is a currently accepted one. In the past, *Janakas* have been defined in other ways, sometimes incompatible with the *sampoorna* characteristic. In the invented scheme, the base *raagas* arise out of systematic permutation of the twelve *swaras* into the seven *swara sthanas* (positions). Seen this way, the novel scheme is more scientific compared to the current organization of the Hindustani music.

As noted before, all base *raagas* employ a complete (*sampoorna*) *aroha* - *avaroha* structure. The lower tetrachord (*purvang*) of a base *raaga* refers to the lower half of *Aroha-Avaroha*, namely Sa-Ri-Ga-Ma and upper tetrachord (*uttarang*) refers to the upper half or Pa-Dha-Ni-Sa.

A first and simplest way to derive a *raaga* from a base *raaga* is to leave out one or more *swaras* in *aroha* or *avaroha*. This method results in an *upang raaga*. Thus, one can see that derived *raagas* form somewhat of a proper subset of a base *raaga*. These missing *swaras* are sometimes called *vajra*. Other ways of creating derived *raagas* include twisting the progression of *aroha* and/or *avaroha*.

CREATING NEW HINDUSTANI RAAGAS USING THE NOVEL METHOD

Using these rules, a novel set of identifiable *thatas* can be compiled and used to create new *raagas* as follows. First, an individual one of the identified *thatas* is taken. For the sake of discussion, let us assume that we select a *thata* of the form {SA, RE, GA, ma, PA, DH, NI, SA}. It can be easily seen that this *thata* has 8 notes, one more than the 7 notes in the *thatas* identified above. This is because a *raaga* has an eighth note, SA appended to it to complete the tune.

This *thata* has 7 notes. As mentioned a *thata* has both ascending (*aroha*) and descending (*avaroha*) orders of notes. *Raaga* in addition needs *vadi/samvadi* to manifest its *swarop*. Accordingly, we can easily see that a descending order of the selected set of notes (*thata*) can be constructed as, {SA, Ni, DH, PA, ma, GA, RE, SA}. Thus, this example shows a complete *raaga* with a total of 14 unique notes (*swaras*), and therefore, this embodiment is called a *Sampurna-Sampurna raaga*.

Other variations—in terms of the number and types of notes in each *raaga*—are also possible. In particular, a *raaga* cannot be created unless there are at least 5 notes (*swara*) and as described above, a *raaga* has at most 7 unique notes. Therefore, it can be easily seen that several *raagas* can be compiled using all possible combinations of 5, 6 and 7 unique notes as shown in Table 1.

Table 1. Raaga Types as Combinations of Different Number of Notes

No.	Ascending (Aaroha)	Descending (Avaroha)	Total notes	Type of <i>raaga</i>
1.	5	5	10	<i>Odava-Odava</i>
2.	5	6	11	<i>Odava-Shadava</i>
3.	5	7	12	<i>Odava-Sampurna</i>
4.	6	5	11	<i>Shadava-Odava</i>
5.	6	6	12	<i>Shadava-Shadava</i>
6.	6	7	13	<i>Shadava-Sampurna</i>
7.	7	5	12	<i>Sampurna-Odava</i>
8.	7	6	13	<i>Sampurna-Shadava</i>
9.	7	7	14	<i>Sampurna-Sampurna</i>

Thus, it can be seen from the table that each *thata* can result in exactly 9 types of *raagas*. Further, each *raaga* uses related notes forming an ordered pair called *vaadi* and

samvaadi, for example, the following notes are 'samvaadis' to each other: $\{\{SA, PA\}, \{RE, DH\}, \{GA, NI\}, \{ma, SA\}\}$.

The rationale for this novel method is as follows. First, it has been observed that the currently known 10 *thatas* are inadequate to express the full flavor of Hindustani music. Because a *thata* contains 7 notes, it can be seen that one can select 7 out of the 12 notes to result in a possible valid 792 *thata* combinations. Of these, every new *thata* must have the note *Sa* fixed, and therefore, this is tantamount to a selection of 6 out of 11 notes to arrive at 462 note combinations. These 462 note combinations are given serial numbers 1:462.

Referring to table 2 below, the known 10 *thatas* are grouped in 8 groups A-G, each containing 4 *thatas*. The reference numbers given relate to the possible 462 valid note combinations of which 8 groups of 4 *thatas* each are identified by applying the rules of construction enunciated herein. For example, 1-4 (173-176) indicates that the group of four *thatas* (1-4) actually belongs to serial numbers (173-176) of the 462 possible valid *thata* combinations.

Table 2. Architecture of Hindustani Music And Room For Innovation

Groups	Reference No.	Notes in first half	Notes in second half	Existing thatas	Scope for Improvement
A	1-4(173-176)	SA re ga ma	4 variable, PA, dh, ni	**2	2 to make 4
B	5-8(183-186)	SA re ga MA	4 variable, PA, dh, ni	*1	3 to make 4
C	9-12(208-211)	SA re GA ma	4 variable, PA, dh, ni	0	4 to make 4
D	13-16(218-221)	SA re GA MA	4 variable, PA, dh, ni	**2	2 to make 4
E	17-20(299-302)	SA RE ga ma	4 variable, PA, dh, ni	**2	2 to make 4
F	21-24(309-312)	SA RE ga MA	4 variable, PA, dh, ni	0	4 to make 4
G	25-28(334-337)	SA RE GA ma	4 variable, PA, dh, ni	**2	2 to make 4
H	29-32(344-347)	SA RE GA MA	4 variable, PA, dh, ni	*1	3 to make 4

8 Groups: 32 Thatas				-----Swara combinations-----	**10 22 to make 32

An analysis of the table 2 shows that each of the eight groups has four *thatas*. As seen from the table below, two groups (C, F) no known *thata* exists, while remaining two groups (B, H) have 1 *thata* each, whereas four groups (A, D, E, G) have two *thatas* each. These are summarized in table 3.

Table 3. Distribution of Known *Thatas* Among 8 Identified Groups

	Number & Names of Group #	Number of Thatas
5	4 (A, D, E, G)	2 (8)
	2 (B, H)	1 (2)
	2 (C, F)	0 (0)

	8 Groups	3 (10)

The other combinations of notes are non-existent in the current Hindustani musical system. This deficiency is rectified by adding new *thatas* as shown in Fig. 1, which shows 10 *thatas* already known and 22 additional *thatas* invented herein.

Thus, the invented method includes applying the following rules to isolate new and unique *thatas*. First note *Sa* is fixed. Then 6 out of the possible 11 remaining notes are taken. Notes *Sa* and *Pa* are fixed. Then only one form of each of the following variable *swaras* (notes) is taken: {*Re*, *Ga*, *Ma*, *Dha*, *Ni*}. Having selected the 7 notes, one can create 22 new *thatas*.

Fig. 1 depicts 32 new *thatas*, which result from this process. Of these, 10 *thatas* are currently in vogue in Hindustani music. But these 10 *thatas*, which are identified by an asterisk, are not developed in a scientific way; rather, they were derived empirically.

For every *thata*, there are 22 possible combinations of notes in ascending and in descending order. Noting that a *raaga* has both ascending and descending set of notes, and further noting that a *raaga* may contain at least 5 notes—i.e., it can have 5, 6 or 7 notes—one can see that 484 distinct *raagas* are possible for each new *thata*. These are the *janya* (derived) *raagas*. From these 484 combinations, a total of 10,648 new *raagas* can be created. The illustration below shows 32 *sampurna-sampurna raagas* (each containing 7 notes in both ascending and descending order) based on 32 *thatas*, which include the 22 newly derived *thatas* and the 10 *thatas* in vogue. The numbers preceding each *thata* indicate the sequence numbers in the format x/y where x is the sequence number of the newly identified *thata*, and y is the sequence number of one of the 462 valid *thata* combinations out of which the 22 new *thatas* are identified.

REPORT

Avaroha : SA ni dh PA ma ga re SA

5 2/174 AaroHa : SA re ga ma PA dh NI SA

Avaroha : SA NI dh PA ma ga re SA

3/175 Aaroha : SA re ga ma PA DH ni SA

Avaroha : SA ni DH PA ma ga re SA

10 Vadi : ma Samvadi : SA

4/176 Aaroḥa : SA re ga ma PA DH NI SA

Avaroha : SA NI DH PA ma ga re SA

Vadi : ma Samvadi : SA

5/183 Aaroha : SA re ga MA PA dh ni SA

15 Avaroha : SA ni dh PA MA ga re SA

Vadi : MA Samvadi : SA

6/184 Aaroha : SA re ga MA PA dh NI SA

Avaroha : SA NI dh PA MA ga re SA

Vadi : MA Samvadi : SA

20 7/185 AaroHa : SA re ga MA PA DH ni SA

Avaroha : SA ni DH PA MA ga re SA

Vadi : MA Samvadi : SA

8/186 Aaroha : SA re ga MA PA DH NI SA

Avaroha : SA NI DH PA MA ga re SA

25 Vadi : MA Samvadi : SA

9/208 Aroha : SA re GA ma PA dh ni SA

Avaroha : SA ni dh PA ma GA re SA

Vadi : SA Samvadi : PA

10/209 Aroha : SA re GA ma PA dh NI SA

30 Avaroha : SA NI dh PA ma GA re SA

Vadi : GA Samvadi : NI

11/210 Aroha : SA re GA ma PA DH ni SA

Avaroha : SA ni DH PA ma GA re SA

Vadi : SA Samvadi : PA

5 12/211 Aroha : SA re GA ma PA DH NI SA

Avaroha : SA NI DH PA ma GA re SA

Vadi : GA Samvadi : NI

13/218 Aroha : SA re GA MA PA dh ni SA

Avaroha : SA ni dh PA MA GA re SA

10 Vadi : SA Samvadi : PA

14/219 Aroha : SA re GA MA PA dh ni SA

Avaroha : SA ni dh PA MA GA re SA

Vadi : SA Samvadi : PA

15/220 Aroha : SA re GA MA PA DH ni SA

15 Avaroha : SA ni DH PA MA GA re SA

Vadi : SA Samvadi : PA

16/221 Aroha : SA re GA MA PA DH NI SA

Avaroha : SA NI DH PA MA GA re SA

Vadi : GA Samvadi : NI

20 **32 S-S (7:7) RAAGAS**

17/299 Aroha : SA RE ga ma PA dh ni SA

Avaroha : SA ni dh PA ma ga RE SA

Vadi : SA Samvadi : PA

18/300 Aroha : SA RE ga ma PA dh NI SA

25 Avaroha : SA NI dh PA ma ga RE SA

Vadi : SA Samvadi : PA

19/301 Aroha : SA RE ga ma PA DH ni SA

Avaroha : SA ni DH PA ma ga RE SA

Vadi : RE Samvadi : DH

20/302 Aroha : SA RE ga ma PA DH NI SA

Avaroha : SA NI DH PA ma ga RE SA

Vadi : RE Samvadi : DH

21/309 Aroha : SA RE ga MA PA dh ni SA

5 Avaroha : SA ni dh PA MA ga RE SA

Vadi : SA Samvadi : PA

22/310 Aroha : SA RE ga MA PA dh NI SA

Avaroha : SA NI dh PA MA ga RE SA

Vadi : SA Samvadi : PA

10 23/311 Aroha : SA RE ga MA PA DH ni SA

Avaroha : SA ni DH PA MA ga RE SA

Vadi : RE Samvadi : DH

24/312 Aroha : SA RE ga MA PA DH NI SA

Avaroha : SA NI DH PA MA ga RE SA

15 Vadi : RE Samvadi : DH

32 S-S (7:7) RAAGAS

25/334 Aroha : SA RE GA ma PA dh ni SA

Avaroha : SA ni dh PA ma GA RE SA

Vadi : SA Samvadi : PA

20 26/335 Aroha : SA RE GA ma PA dh NI SA

Avaroha : SA NI dh PA ma GA RE SA

Vadi : GA Samvadi : NI

27/336 Aroha : SA RE GA ma PA DH ni SA

Avaroha : SA ni DH PA ma GA RE SA

25 Vadi : RE Samvadi :DH

28/337 Aroha : SA RE GA ma PA DH NI SA

Avaroha : SA NI DH PA ma GA RE SA

Vadi : GA Samvadi : NI

29/344 Aroha : SA RE GA MA PA dh ni SA

Avaroha : SA ni dh PA MA GA RE SA

Vadi : SA Samvadi : PA

30/345 Aroha : SA RE GA MA PA dh NI SA

5 Avaroha : SA NI dh PA MA GA RE SA

Vadi : GA Samvadi : NI

31/346 Aroha : SA RE GA MA PA DH ni SA

Avaroha : SA ni DH PA MA GA RE SA

Vadi : SA, or RE Samvadi : PA, or DH

10 32/347 Aroha : SA RE GA MA PA DH NI SA

Avaroha : SA NI DH PA MA GA RE SA

Vadi : SA or RE or GA Samvadi : PA or DH or NI

The foregoing describes a scientific and logical basis for restructuring *thata* and Janya Raagas in Hindustani music system and expands the Hindustani music to contain 22 new *thatas* and 10,648 *raagas*. It is believed that this helps create additional melodies. Further, a programmed computer can be developed to create new *raagas* in the Hindustani music based on the novel *thata* combinations. Other instruments, such as fretted instruments may be created using the principles described herein. Accordingly, the principles disclosed herein should not be limited to those embodiments specifically stated herein.